JPRS L/10599

18 June 1982

East Europe Report

SCIENTIFIC AFFAIRS

(FOUO 3/82)

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

APPROVED FOR RELEASE: 2007/02/09: CIA-RDP82-00850R000500070045-0

JPRS L/10599

18 June 1982

EAST EUROPE REPORT

SCIENTIFIC AFFAIRS

(FOUO 3/82)

CONTENTS

CZECHOSLOVAKIA

BOTTOM POURING OF HIGH-ALLOY STEEL PRODUCES IMPROVED YIELDS

Prague HUTNICKE LISTY in Czech No 2, 1982 pp 128-130

[Article by Eng Vladimir Hrabe and Eng Jiri Bauer, POLDI United Steelworks National Enterprise [POLDI SONP], Kladno: "Potential for Increasing Yield in the Casting of High-Alloy Steels"]

[Text] The casting of corrosion-proof, heat-resistant and heatproof steels is technologically very demanding. These steels can loosely be classified in two groups, ferritic and austenitic. These high-alloy steels contain large quantities of alloy additions, particularly chromium and nickel, but also molybdenum and tungsten, while some steels also contain even smaller quantities of titanium or niobium. Most of them have low or very low carbon content, although a few have medium carbon content.

Some varieties have a strong tendency to form a transcrystallization zone to an extent which makes them difficult to shape. This necessitates slow casting at a low temperature. Others must be cast quite rapidly. These steels, for example austenitic steels stabilized with titanium, contain metals with a great affinity for oxygen and nitrogen which combine easily with these gases, forming compounds that produce a protective slag layer with a tendency to coagulate. As a result, the slag becomes thicker and casting becomes more difficult; surface defects may be produced in the ingots as a result of large surface inclusions.

Some high-alloy steels, particularly austenitic types, are extremely tough, so that pouring assemblies are difficult to take apart and may be damaged when the ingot is being freed. It is difficult to increase ingot weight. Plant 1 of POLDI SONP has long practiced top-pouring of high-alloy steel into ingot molds producing 4,900-kg ingots. With top pouring it is very difficult to prevent the steel from splashing when it strikes the bottom of the mold, and the speed of casting can be controlled only by selecting the diameter of the fireclay nozzle, which cannot be changed during the course of casting. The operation of the protective slag layer is extremely unstable during top pouring, particularly as a result of splashing at the place where the stream strikes. Thus the simplicity of this type of casting is dearly paid for in subsequent stages of production.

Design Constraints

These considerations led the steelworkers of POLDI plant 1 to the decision to change over to bottom pouring, even though this meant reconstructing the entire casting system. The reconstruction had to meet the following requirements:

--allowing the casting of high-alloy steel at a wide range of casting speeds;

--replacing classical hot tops with insulating plates, along with reconstruction of the upper parts of the molds; the plates were to be designed so as to decrease ingot croppage losses.

--solving or eliminating difficulties expected in the bottom pouring process during breaking down of the pouring assembly and removal of the ingot (breakage of the ingate neck without the use of force);

--designing critical locations with fireclay shapes which would limit leakage of steel under considerable ferrostatic pressure.

Solution

The operating system in the foundry made it impossible to bottom-pour more than two ingots at one time. The basic specifications for the bottom-pouring molds were not substantially altered from those of the top-pouring molds, but the bottoms had to be redesigned and the top sections lengthened so that the hot top could be assembled from insulating plates. The mold dimensions can be seen in Fig 1. This is an octagonal mold with a rather large taper of 4.4 percent and a width-to-thickness ratio of 3.7. The hot top is formed by eight insulating plates.

Heavy fireclay neck-down cores were used as mold gates (Fig 2). It was necessary to use large cores so that the mold could not damage them when it was set on the stool [bottom plate]. The core was purposely designed to form a weak point on which stress would be concentrated when the cast ingot was removed from the mold, thus assuring that the neck would break at that place. The flow of steel is relatively quiet over an increased area, governed by the size of the cavity (a conical frustum) in the core, so that filling of the lower part of the mold proceeds smoothly.

The upper part of the casting stool is lined with firebrick runners, a connecting runner and an end runner. The runner diameter was chosen as 45 mm with positive tolerance to enable the required casting speed to be achieved. The fountain was initially made of hematite, but subsequently a cast sheet steel fountain was used to increase operating life. The junction between the fountain and the stool is the weakest and most vulnerable point in the entire pouring assembly. The vertical flow, which at least initially arrives with considerable kinetic energy, is drawn off horizontally by a firebrick distributing block. A considerable ferrostatic pressure is gradually developed in the system because of the height of the fountain (2,900 cm) and the mold (2,430 mm). In order to prevent leakage of steel

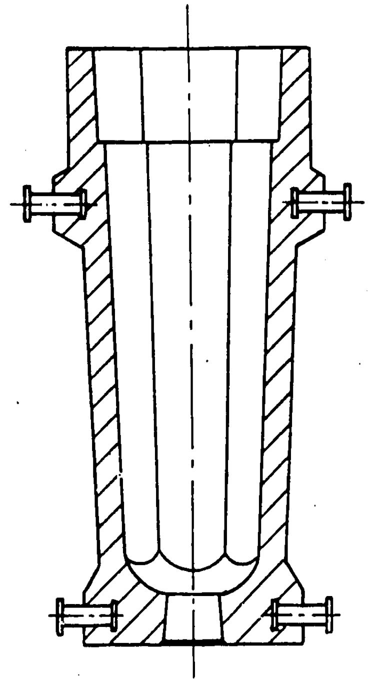

Figure 1. Mold for casting high-alloy steel ingots for foundry

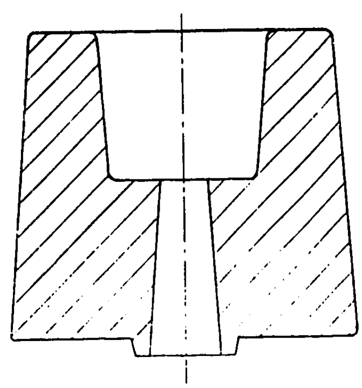

Figure 2. Fireclay core (insert) for bottom of mold, used in casting 5-ton ingots

at these locations not only were the connections made by the usual key and lock method, but in addition the horizontal gap between the fountain and the stool was blocked by a fireclay insert which extends as far as the body of the end runner in the fountain and to the distributing block in the stool. This method creates a labyrinth which cools any steel leaking into it so that it hardens and prevents further steel leakage. (See assembly in Fig 3).

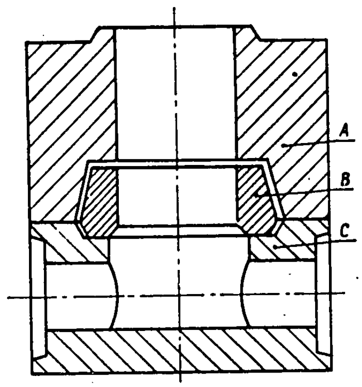

Figure 3. Combination of end tube of fountain, insert and distributing 1 block in mold stool

Key:
- A. End tube
- B. Insert blocking gap between fountain and stool
- C. Fireclay distributing block in mold stool

The diameter of the tubing in the fountain is 80 mm. Thus the ratio of the cross-sectional area of the fountain to the sum of the cross-sectional areas of the connecting runners is 1.56, which is sufficient to create an excess pressure in the fountain, thus allowing a considerable range of casting speeds. The maximum casting speed with this system is over 3 tons a minute, while relatively low casting speeds are also possible.

Technical Evaluation of the Results Achieved

The introduction of this runner system was attended by a number of difficulties. This is understandable because it increases the demands on the foundry workers, while the technical, economic and labor effects show up only at the steel mill. Initially, pouring assembly life was short; disassembly after casting was a particular problem in this connection. Now the technology, and thus the life of the individual pouring assembly components, has been stablized to the point that the entire operation can be evaluated, even though certain problems still remain.

A. The Ingot Mold

Over the long term, an average of 14.5 castings per mold was achieved. This is a short life, resulting from intermittent use, since 5-ton high-alloy steel ingot casting runs for the forging shops are irregular, and in this type of use cycle the mold life is not comparable with that of molds in a regular-use cycle. The other causes for short mold life should be resolvable. (See below.)

B. Metal Fountain

This has a long life and its design may be considered satisfactory.

C. Casting Stool

This is also suitable for use with the metal fountain.

Effectiveness of the Technological Measures Undertaken

A. Breaking Away of Ingot from Ingate Neck

Concentration of stress on the taper below the bottom of the ingot occurs in about 80 percent of cases. When the neck does not break off, of course, its excessive strength hinders removal of the ingot from the mold, so that it is necessary to use force, which may result in breakage of the mold. In accordance with the investigations undertaken in preparation for the study, it will be necessary to redesign the fireclay neck-down core; according to experience, a cylindrical shape, which will not hinder release of the ingots and thus will not threaten the casting process, should be used.

Leakage protection in the apparatus is good and meets requirements.

B. Ingot Surface Quality

The ingot surface quality has been greatly improved and in particular there are no bottom losses, which in top pouring were extremely bad as a result of splashing.

In the earlier cycle, after cooling, the ingots were first machined by turning, then forged to the specified dimensions, after which the square section was again finished with a milling cutter. Of course, in forging too there were ingot bottom losses, frequently to a height of 500 mm.

In the new technology, with bottom-pouring the ingots are sent to the forging shop while hot and are forged after supplementary heating. Bottom losses generally do not exceed 2 percent. The square blocks are sent back to the machine shop for finish milling after forging.

Technically the results may be characterized as follows:

1. Elimination of metal losses during forging and the use of a single machining operation increased metal yield by at least 15 percent;

2. The process cycle was speeded up by about 14 days by eliminating the first finishing operation;

3. Energy requirements were decreased by about 50 percent, since in the earlier process, cold ingots were heated to the forging temperature, while in the new process only a supplementary heating to the forging temperature is required.

Reflection of the Technological Measures in Economic Figures

In the production of about 3,000 tons of 5-ton high-alloy steel ingots a year the economic effect was as follows:

1. An increase of Kcs 345,000 in costs after the changeover to bottom pouring, even with the service life of the metal parts of the pouring apparatus that has been achieved;

2. A decrease of Kcs 2,182,000 in costs as a result of more complete use of metal, decreased energy consumption and elimination of some machining operations;

3. The overall effect is a decrease of Kcs 1,837,000 in production costs.

Conclusion

The process of casting 5-ton ingots for the forging mills was changed, replacing top pouring with bottom pouring. This resulted in a considerable increase in the metal utilization rate, a saving of energy and a shortening of the process cycle, yielding an annual saving of approximately Kcs 1,837,000 compared with the situation before the changes were made. Experience indicates that the saving can be increased even further by eliminating certain defects.

8480
CSO: 2402/35

CZECHOSLOVAKIA

GASOLINE TRENDS, PRODUCTION SURVEYED

Prague CHEMICKY PRUMYSL in Czech No 2, 1982 supplement CHEMIE A LIDE pp 3-6

[Article by Oldrich Svajgl: "Improving the Quality of Automotive Gasolines in Czechoslovakia"]

[Extracts] Environmental protection and a considerable increase in the price of crude oil were the primary factors in the development of the automotive industry and automotive fuels production worldwide during the last decade. Views on conventional fuel for internal combustion engines changed more fundamentally during that period than in the several decades preceding it. At the beginning of the 1970's we too created a research base for increasing the output and improving the quality of automotive fuels. This measure led to a number of recommendations for modernizing the processes for producing gasoline ingredients, for the introduction of new processes for producing hydrocarbon components, and for the use of nonhydrocarbon additives of various types, including optimizing the types and quantities of lead-based antiknock additives. At the beginning of the 1980's the Czechoslovak refining industry is preparing for a number of changes in gasoline production and quality. This article discusses the main changes in output and quality, particularly in Chemopetrol's refineries, during the 1980's. All of these changes are being made in connection with the two main factors, mentioned above, that govern output, economy and emissions.

The Situation in Czechoslovakia During the 1970's

In the 1970's there were some changes in the Czechoslovak motor vehicle inventory's gasoline requirements. As older vehicles went out of service, interest in NORMAL gasoline, with an octane number of 80, decreased to the point that it was almost completely abandoned. Most new Skoda vehicles and imported models did not have high compression ratios as was the case in the west. As a result, the ratio between the two high-octane gasoline varieties was the reverse of the situation in Western Europe, where the PREMIUM (SUPER) variety with an octane number of 96-99 predominates. The price difference between the two varieties was disproportionate to the difference in production cost and was always higher than in the developed countries, which led to increased interest in medium-compression vehicles in spite of the greater economy of high-compression engines.

Automotive gasoline was produced in Czechoslovakia by three hydroskimming refineries: Slovnaft, Chemicke Zavody CSSP [CHZ CSSP: Czechoslovak-Soviet Friendship Chemical Works], and Kaucuk, in order of annual output capacity. The refineries had similar technical facilities, so that both of the main types of gasoline, BA-90 and BA-96, differed very little in chemical composition.

The gasolines were produced from light gasoline distilled directly from petroleum and catalytically reformed products. The desired octane number was achieved by varying the proportion of the two main components and the amount of lead added. Tetraethyl lead [TEL] was added to SPECIAL gasoline, and tetramethyl lead [TML] to SUPER, in the standard lead concentrations of 0.60 to 0.77 g/liter.

There was a great difference between the antiknock properties of the light and heavy components of SPECIAL gasoline, so that its highway octane number was low at low engine speeds. The gasoline was nonolefinic and had only a small quantity of aromatics, so that it has a low sensitivity to changing engine speed.

SUPER gasoline with TML had all the properties of a high-quality gasoline with a high highway octane number and low sensitivity (difference between OCVM and OCMM [?research octane number, motor octane number]).

By the end of the 1970's, long-term research had achieved the following:

improved the quality of the varieties of gasoline supplied and decreased their production cost;

provided data on other fractions for production during the 1980's, particularly data on improving reforming, introducing isomerization, producing and using MTBE [methyl t-butyl ether], and fuller of the waste fractions of pyrolytic gasolines;

provided the preconditions for decreasing the lead content of gasoline and adding detergents to it.

At the end of the 1970's all refineries began to produce improved SPECIAL gasoline and some improved SUPER in accordance with research results.

The difference between the octane numbers of the light and heavy components of SPECIAL was decreased by adding a 3:1 mixture of TML and TEL (designated PM-75). The highway octane number at low and high speeds was improved by decreasing $\Delta R_{100° C}$ and by the use of TML. Its highway octane number exceeded that of Soviet AI-93 gasoline, specially produced for the Lada. The addition of linear alcohols [alkyloly] decreased production costs by 2 to 3 percent.

With PM-75 added, the antiknock characteristics of SUPER gasoline remained at the same level, but its production cost was decreased.

New Gasoline Components in Czechoslovak Refineries During the 1980's

All three of our refineries made changes in their structure at the end of the 1970's. The simple refinery flowsheet was expanded to include new facilities, whose introduction primarily affected automotive fuels. The changes differed at each refinery, so that in the 1980's Czechoslovak gasolines will have different compositions. The refineries are preparing to decrease the lead content of gasolines as much as they can, and possibly to change the relative proportions of their products, i.e. to change over to the higher quality SUPER gasoline for most motor vehicles.

Slovnaft National Enterprise, which is the largest producer of automotive gasoline in Czechoslovakia (50 percent), plans the largest changes in gasoline production. Its main gasoline source will remain the catalytic reforming of heavy gasolines, which will yield a product with an octane number of about 92 and a distillation characteristic which differs very little from that of the final gasolines. The primary light components are desired here for pyrolysis; thus some waste light gasoline from petroleum refining, particularly light reformate and light pyrolytic gasoline, are used. Both light components have better antiknock characteristics, so that they yield a better value of $\Delta R_{100°\,C}$. Limitation of the amounts of low-octane light components added results in an "excess" octane number for blending, so that gasoline with a relatively low content (0.2-0.6 g/liter) is now being produced. But Slovnaft is not yet taking advantage of the economic benefits of adding PM-75 to SUPER gasoline.

The Czech refineries have made their preparations to decrease lead content and to switch to high-octane types in different ways.

CHZ CSSP in Litvinov is still expanding its range of components to include pyrolytic gasoline and C_5-C_6 isomerizate. It is expected to have 80,000 to 100,000 tons of light and heavy pyrolytic fractions (C_5 and C_9+ fractions), i.e. 20 to 25 percent of the total output, for the production of automotive gasoline. These fractions have favorable octane characteristics; the light fraction replaces poor-quality light gasoline and evens out the octane characteristics of the blended gasoline, while the heavy fraction replaces reformate. The olefin content has some effect on the engine octane number, and thus on the highway octane number at high engine speed. Another fraction for automotive gasoline, C_5-C_6 isomerizate, will soon be obtained from light petroleum gasoline. This contains primarily the high-octane components isopentane and isohexane, and is very sensitive to lead. The isomerizate is an alternative to the C_5 fractions from pyrolysis, some of which will be shipped elsewhere. CHZ CSSP will not have light low-octane components available to it; the automotive gasolines which it produces have all the prerequisites for low-lead varieties (as little as 0.15 g/liter). If a fluid catalytic cracker is built at the end of the 1980's, CHZ CSSP's gasoline will be a high-olefin type, with high sensitivity to changes in engine speed, and almost lead-free. The tendency to form gums and deposits must be regulated by detergents and antioxidants to a greater degree than otherwise.

Kauchuk Kralupy adds to its gasoline up to 15 percent of an important non-hydrocarbon component, MTBE. The effect of this compound on the output and quality of gasoline in this refinery was studied in detail. MTBE only slightly decreases the caloric content of the gasoline, while it improves the antiknock properties of the light gasoline and has a considerable effect on the octane number (the octane number of the blend is 120-130). MTBE is produced from the C_4 fraction obtained from pyrolysis and methanol, and is more soluble in hydrocarbons and less soluble in water than alcohols are. The MTBE apparatus allows Kaucuk Kralupy to produce both gasoline varieties with 0.15 g/liter of lead, to decrease the aromatic content of the gasolines by 10 to 15 percent and to use light hydrocarbons from petroleum for petrochemical production.

Thus anyone who drives through Czechoslovakia in the 1980's will have available to him three different gasolines of the same octane number, all meeting Czechoslovak norms and the "appetite" of this vehicle. The lead content of the gasoline, and thus of the emissions, will fall to about a quarter of the earlier value.

If every refinery included a detergent additive, average fuel consumption will decrease by about 4 percent and the concentration of CO and hydrocarbons in emissions will be lowered.

Conclusion

In agreement with worldwide tendencies, during the 1980's there will be changes in gasoline production and its quality in Czechoslovakia. The refiners are already improving existing catalytic reforming processes, introducing light gasoline isomerization processes and catalytic cracking of solar oil, and using optimal components from pyrolysis. In addition, large quantities of MTBE will be manufactured and added to gasolines. The resulting gasolines will have low lead content, with comparable octane characteristics along the distillation curve, and for the most part will also have smaller sulfur concentrations, while detergents added in concentrations of 20 to 100 ppm will have a favorable effect on mileage and emissions. The refineries are also providing an octane number margin against a possible change in automobile requirements to high-octane gasolines as a result of higher compression ratios, which will give more economical operation.

8480
CSO: 2402/47

END